VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

April 18, 2001

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 2
CYCLE 15 CORE OPERATING LIMITS REPORT

Pursuant to North Anna Technical Specification 6.9.1.7.d, attached is a copy of the Virginia Electric and Power Company's (Dominion) Core Operating Limits Report for North Anna Unit 2 Cycle 15 Pattern OX.

No new commitments are intended by this letter. If you have any questions or require additional information, please contact us.

Very truly yours,

S. P. Sarver, Director
Nuclear Licensing and Operations Support

Attachment

cc: U.S. Nuclear Regulatory Commission
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Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

A001

CORE OPERATING LIMITS REPORT
North Anna 2 Cycle 15 Pattern OX
Rev 0

March 2001

Virginia Electric and Power Company
(Dominion)

N2C15 CORE OPERATING LIMITS

1.0 INTRODUCTION

The Core Operating Limits (COLR) for North Anna Unit 2 Cycle 15 were prepared in accordance with North Anna Unit 2 Technical Specification 6.9.1.7. The technical specifications affected by this report are listed below:

3/4.1.1.4	Moderator Temperature Coefficient
3/4.1.3.5	Shutdown Bank Insertion Limit
3/4.1.3.6	Control Bank Insertion Limits
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor and Power Factor Multiplier

The cycle-specific parameter limits for North Anna 2 Cycle 15 for the specifications listed above are provided on the following pages, and were developed using the NRC-approved methodologies specified in Technical Specification 6.9.1.7.

The heat flux hot channel factor surveillance specification 4.2.2.2 requires the application of a cycle dependent non-equilibrium multiplier, N(z), to the measured $F_Q(z)$ before comparing it to the limit. N(z) accounts for power distribution transients encountered during normal operation. As function N(z) is dependent on the predicted equilibrium $F_Q(z)$ and is sensitive to the axial power distribution, it is necessary to generate this function based on the actual EOC burnup distribution that can only be calculated after shutdown of the previous cycle. The N(z) function is presented in Table 1.

The reduced $F_Q(z)$ limit applicable for EOC Tavg and power coastdown operation is provided in this COLR.

2.0 OPERATING LIMITS

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.4)

2.1.1 The moderator temperature coefficient (MTC) limits are:

The BOC/ARO-MTC shall be less positive than or equal to +0.6E-4 Δk/k/°F (+6 pcm/°F) below 70 percent of RATED THERMAL POWER.

The BOC/ARO-MTC shall be less positive than or equal to 0 (zero) Δk/k/°F (0 pcm/°F) at or above 70 percent of RATED THERMAL POWER.

The EOC/ARO/RTP-MTC shall be less negative than -5.0E-4 Δk/k/°F (-50 pcm/°F).

2.1.2 The MTC surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -4.0E-4 Δk/k/°F (-40 pcm/°F).

The 60 ppm/ARO/RTP-MTC should be less negative than or equal to -4.7E-4 Δk/k/°F (-47 pcm/°F).

Where BOC - Beginning of Cycle
ARO - All Rods Out
EOC - End of Cycle
RTP - RATED THERMAL POWER

2.2 Shutdown Bank Insertion Limit (Specification 3/4.1.3.5)

2.2.1 The shutdown rods shall be withdrawn to at least 226 steps.

2.3 Control Bank Insertion Limits (Specification 3/4.1.3.6)

2.3.1 The control rod banks shall be limited in physical insertion as shown in Figure 1.

2.4 Axial Flux Difference (Specification 3/4.2.1)

2.4.1 The axial flux difference limits are provided in Figure 2a and Figure 2b.

2.5 Heat Flux Hot Channel Factor-$F_Q(z)$ (Specification 3/4.2.2)

The change in the FQ limit for temperature coastdown is accommodated by defining a variable limit, FQ_{lim} as indicated below. Then, the following expressions can be used for both normal operation and Tavg coastdown regimes.

FQ_{lim} = 2.19, for normal operation at full power;

FQ_{lim} = 2.15, for flux map immediately preceding EOC temperature coastdown and during subsequent power coastdown operation.[#]

2.5.1 The $F_Q(z)$ limits are:

$$F_Q(z) \leq \frac{FQ_{lim}}{P} * K(z) \text{ for } P > 0.5$$

$$F_Q(z) \leq 2 * FQ_{lim} * K(z) \text{ for } P \leq 0.5$$

where: $P = \dfrac{\text{Thermal Power}}{\text{Rated Thermal Power}}$, and

K(z) is provided in Figure 3

2.5.2 The $F_Q(z)$ surveillance limits are:

$$F_Q^M(z) \leq \frac{FQ_{lim}}{P} * \frac{K(z)}{N(z)} \text{ for } P > 0.5$$

[#] NAPS 1 & 2 Safety Evaluation No. 99-SE-OT-26 Rev 1, 08/05/1999

$$F_Q^M(z) \le 2 * FQ_{lim} * \frac{K(z)}{N(z)} \text{ for } P \le 0.5$$

where: $P = \dfrac{\text{Thermal Power}}{\text{Rated Thermal Power}}$, and

K(z) is provided in Figure 3; and

N(z) is a non-equilibrium multiplier on $F_Q^M(z)$ to account for power distribution transients during normal operation, provided in Table 1[##].

2.6 Nuclear Enthalpy Rise Hot Channel Factor - FΔH(N) and Power Factor Multiplier (Specification 3/4.2.3)

$$F\Delta H(N) \le 1.49 * \{1 + 0.3 * (1 - P)\}$$

where: $P = \dfrac{\text{Thermal Power}}{\text{Rated Thermal Power}}$

[##] Ref: ET NAF 2001-0033 Rev 0, 03/23/2001

Table 1

N2C15 Normal Operation N(z)

Node	Height (ft)	0 to 1000 MWD/MTU	1000 to 3000 MWD/MTU	3000 to 5000 MWD/MTU	5000 to 7000 MWD/MTU	7000 to 9000 MWD/MTU	9000 to 17800 MWD/MTU	17800 to EOC MWD/MTU
10	10.2	1.168	1.168	1.168	1.140	1.140	1.140	1.116
11	10.0	1.166	1.166	1.166	1.140	1.140	1.140	1.117
12	9.8	1.163	1.163	1.163	1.138	1.138	1.138	1.124
13	9.6	1.160	1.160	1.160	1.138	1.138	1.138	1.134
14	9.4	1.160	1.160	1.160	1.140	1.140	1.142	1.142
15	9.2	1.164	1.164	1.164	1.145	1.145	1.149	1.149
16	9.0	1.170	1.170	1.170	1.148	1.148	1.155	1.155
17	8.8	1.177	1.177	1.177	1.153	1.153	1.160	1.160
18	8.6	1.181	1.181	1.181	1.159	1.159	1.164	1.164
19	8.4	1.184	1.184	1.184	1.165	1.165	1.168	1.168
20	8.2	1.186	1.186	1.186	1.169	1.169	1.173	1.173
21	8.0	1.187	1.187	1.187	1.171	1.171	1.178	1.178
22	7.8	1.187	1.187	1.187	1.173	1.173	1.182	1.182
23	7.6	1.186	1.186	1.186	1.173	1.173	1.185	1.185
24	7.4	1.183	1.183	1.183	1.171	1.171	1.187	1.187
25	7.2	1.179	1.179	1.179	1.168	1.168	1.188	1.188
26	7.0	1.174	1.174	1.174	1.163	1.163	1.186	1.186
27	6.8	1.167	1.167	1.167	1.158	1.158	1.184	1.184
28	6.6	1.159	1.159	1.158	1.152	1.152	1.180	1.180
29	6.4	1.150	1.150	1.149	1.146	1.146	1.173	1.173
30	6.2	1.138	1.138	1.141	1.141	1.141	1.165	1.165
31	6.0	1.126	1.126	1.136	1.137	1.137	1.158	1.158
32	5.8	1.114	1.114	1.132	1.132	1.132	1.152	1.152
33	5.6	1.098	1.098	1.125	1.126	1.126	1.149	1.149
34	5.4	1.089	1.089	1.118	1.118	1.118	1.144	1.144
35	5.2	1.086	1.086	1.108	1.108	1.108	1.133	1.133
36	5.0	1.090	1.090	1.103	1.103	1.103	1.125	1.125
37	4.8	1.095	1.095	1.106	1.106	1.106	1.121	1.121
38	4.6	1.101	1.101	1.110	1.110	1.110	1.122	1.122
39	4.4	1.106	1.106	1.113	1.113	1.113	1.126	1.126
40	4.2	1.110	1.110	1.117	1.117	1.117	1.129	1.129
41	4.0	1.113	1.113	1.122	1.122	1.122	1.131	1.131
42	3.8	1.115	1.115	1.126	1.126	1.126	1.134	1.134
43	3.6	1.118	1.118	1.130	1.130	1.130	1.138	1.138
44	3.4	1.123	1.123	1.134	1.134	1.134	1.141	1.142
45	3.2	1.132	1.132	1.140	1.140	1.140	1.145	1.145
46	3.0	1.140	1.140	1.146	1.146	1.146	1.148	1.146
47	2.8	1.148	1.148	1.154	1.154	1.154	1.154	1.149
48	2.6	1.156	1.156	1.162	1.162	1.162	1.161	1.155
49	2.4	1.164	1.164	1.170	1.170	1.170	1.170	1.163
50	2.2	1.171	1.171	1.178	1.178	1.178	1.178	1.170
51	2.0	1.178	1.178	1.186	1.186	1.186	1.185	1.180
52	1.8	1.185	1.185	1.193	1.193	1.193	1.193	1.191

Figure 1

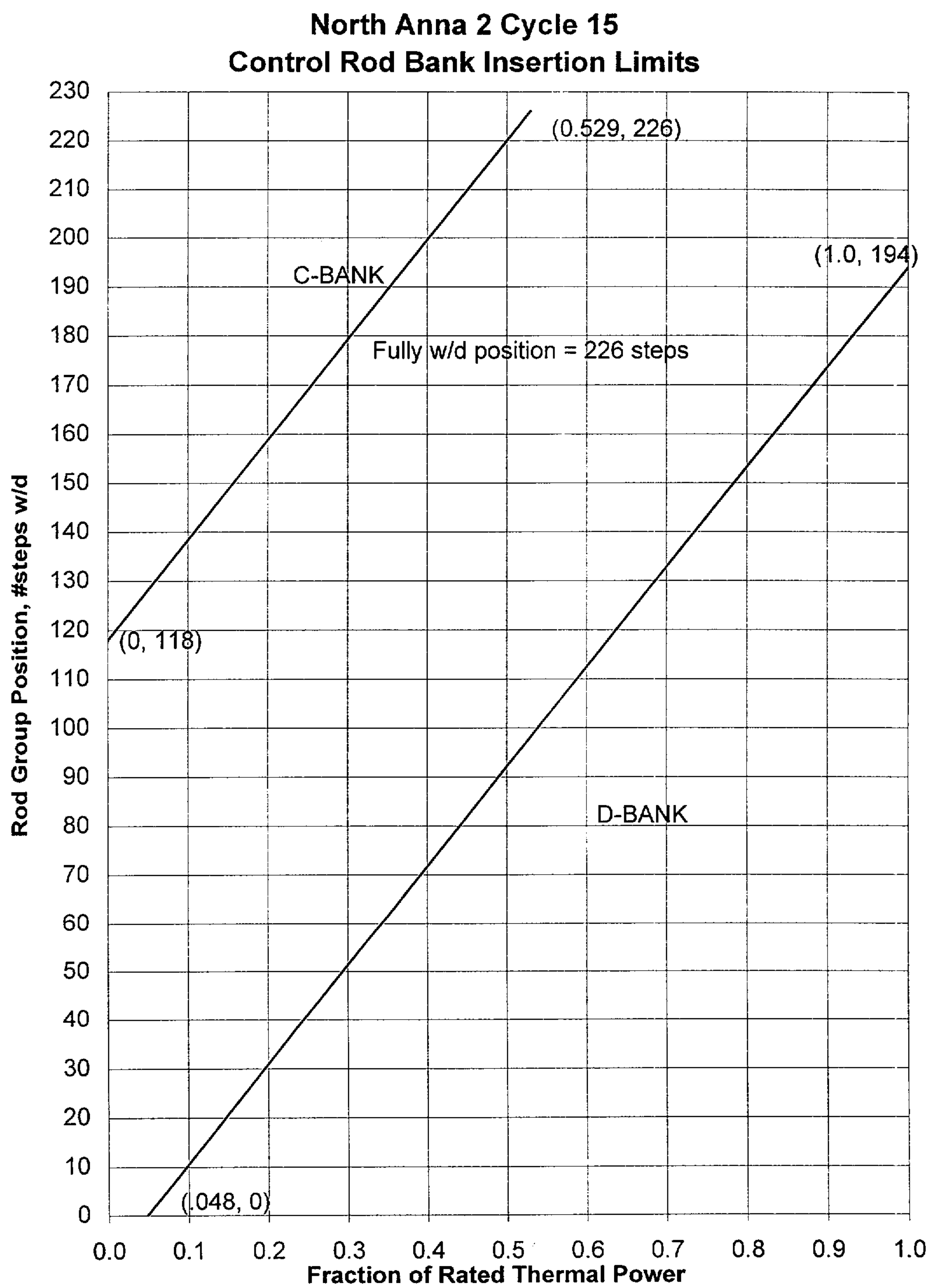

North Anna 2 Cycle 15
Control Rod Bank Insertion Limits
Rod Group Position, #steps w/d
Fraction of Rated Thermal Power
(0.529, 226)
(1.0, 194)
C-BANK
Fully w/d position = 226 steps
(0, 118)
D-BANK
(.048, 0)
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Figure 2a
N2C15 Axial Flux Difference Limits
Normal Operation
Through End of Full Power Reactivity

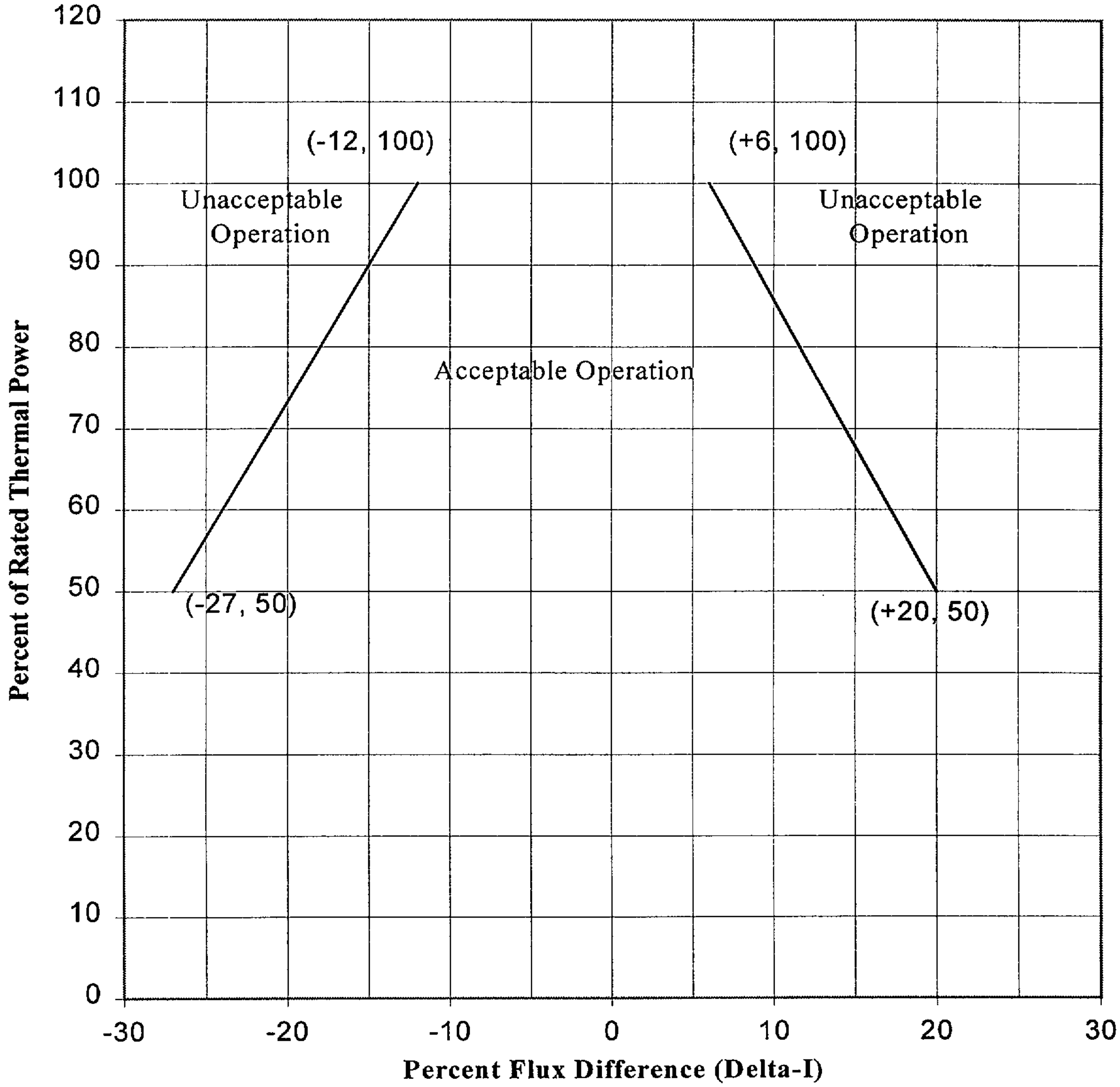


Figure 2b
N2C15 Axial Flux Difference Limits
Coastdown Operation

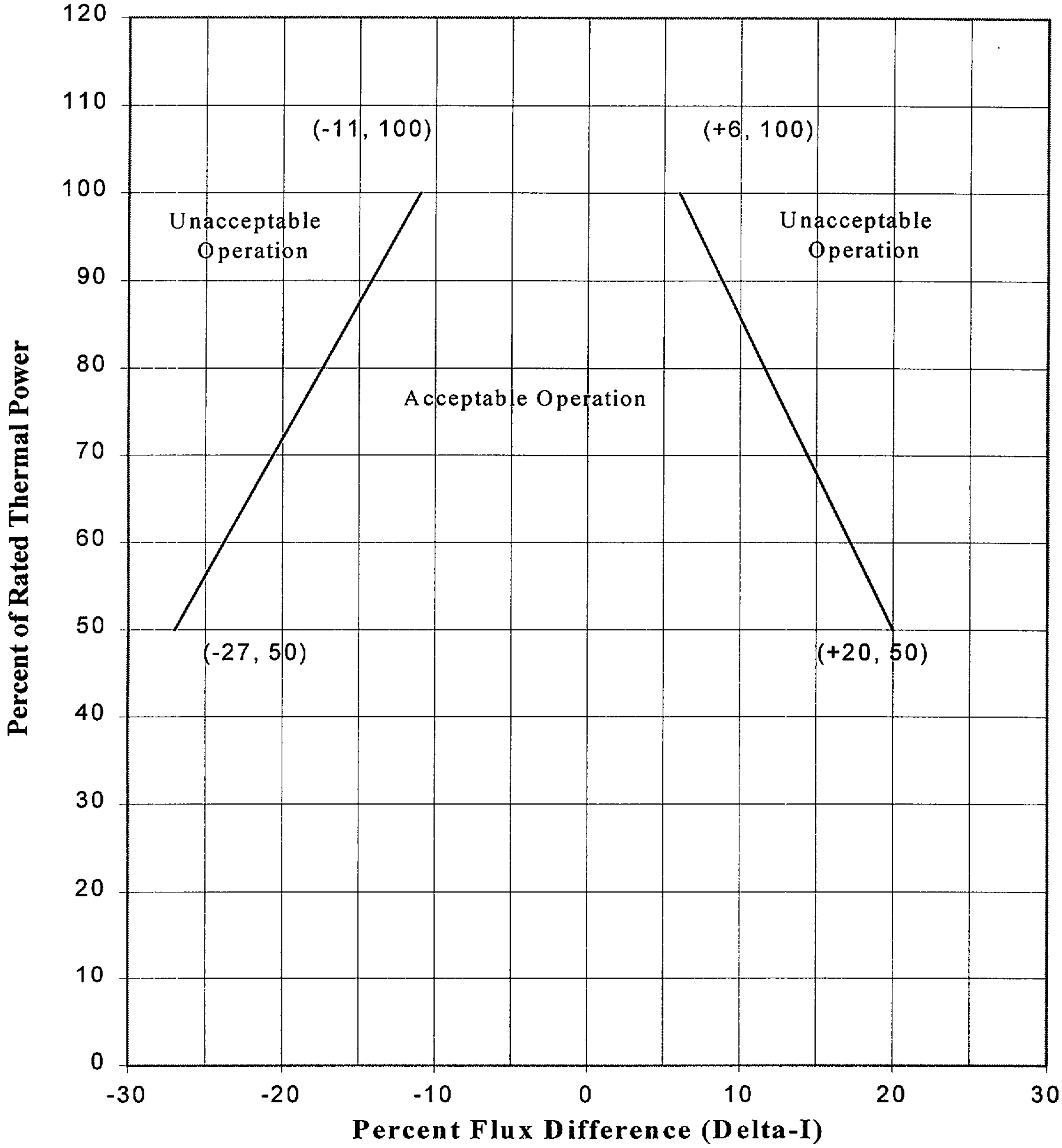
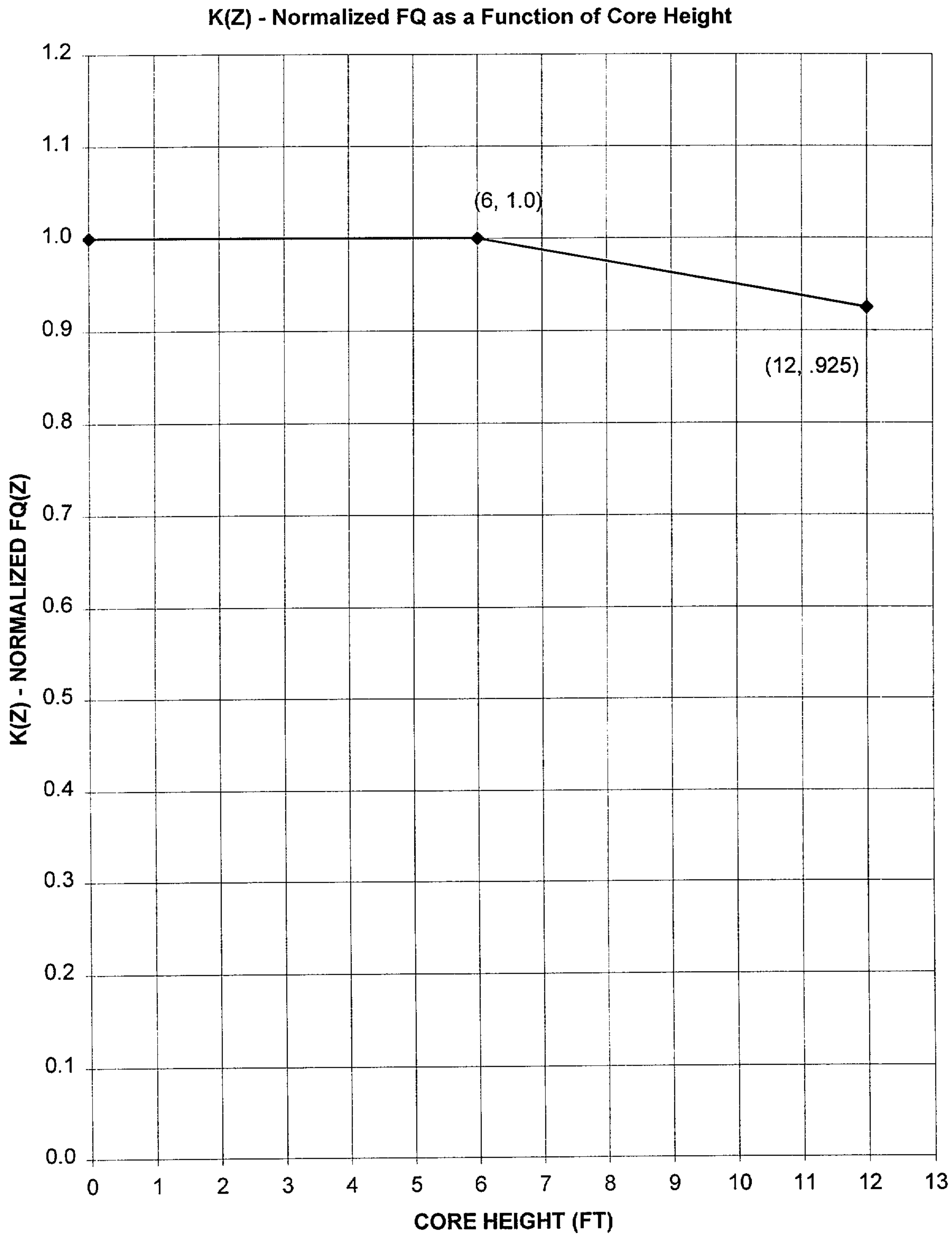


Figure 3


K(Z) - Normalized FQ as a Function of Core Height
K(Z) - NORMALIZED FQ(Z)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(6, 1.0)
(12, .925)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
CORE HEIGHT (FT)